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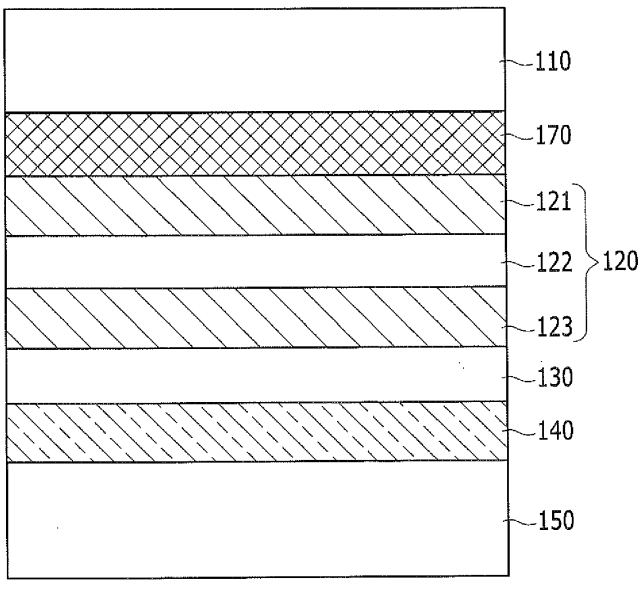
(54) Touch panel display device

(57) A touch panel display device including a display panel displaying an image; a polarizing plate attached onto the display panel; a touch panel on and spaced apart from an upper portion of the polarizing plate; a resin layer between the touch panel and the polarizing plate, the resin layer bonding the touch panel and the polarizing plate; a window on the touch panel; and a reinforcement layer between the window and the touch panel or between the touch panel and the resin layer, wherein the reinforcement layer prevents damage to the touch panel caused by bending stress.

FIG. 1



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Description

BACKGROUND

1. Field

[0001] The present invention relates to a touch panel display device.

2. Description of the Related Art

[0002] Display devices include a liquid crystal display (LCD), a plasma display panel (PDP), an organic light emitting diode (OLED) display, a field effect display (FED), an eletrophoretic display device, and the like. Recently, developed display devices are capable of being bent, folded, or rolled.

[0003] A touch panel that may be used as an input device is sometimes installed in the display device. The touch panel may be a resistive type touch panel, a capacitive type touch panel, or an electro-magnetic type touch panel according to the devised method for sensing touch of the touch panel.

[0004] In the case of the capacitive type touch panel, a voltage drop occurs when a conductor (like a finger or a pen) becomes close to an upper glass substrate or touches the upper glass substrate to input a user's command or graph information by detecting a location being touched.

[0005] Touch panels are susceptible to damage, particularly when the touch panel is bent or deformed in some other way.

[0006] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY

[0007] The invention sets out to provide a touch panel display device that can help reduce and/or prevent breakage or damage to a touch panel attached to a display device due to bending stress.

[0008] Accordingly, a touch panel display device according to an embodiment of the invention includes: a display panel displaying an image; a polarizing plate attached onto the display panel; a touch panel disposed in an upper portion at a distance from the polarizing plate; a resin layer disposed between the touch panel and the polarizing plate to bond the touch panel and the polarizing plate; a window disposed on the touch panel; and a reinforcement layer disposed at least between the window and the touch panel and between the touch panel and the resin layer, and the reinforcement layer may prevent damage to the touch panel due to bending stress.

[0009] In this case, the reinforcement layer may be made of an oxide semiconductor.

[0010] The reinforcement layer may be made of an oxide semiconductor and a metal.

[0011] In this case, the oxide semiconductor may be one of an oxide having zinc, gallium, tin, or indium as a base, complex oxides thereof, such as zinc oxide, indium-gallium-zinc oxide, indium-zinc oxide, or zinc-tin oxide.

[0012] The metal may be one of copper, ITO, and aluminum.

[0013] The reinforcement layer may be formed of a plurality of layers.

[0014] At least some of the abofe and other features of the invention are set out in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 illustrates a cross-sectional view of a touch panel display device according to a first embodiment of the invention.

[0016] FIG. 2 illustrates an equivalent circuit of a pixel of a display panel shown in FIG. 1.

[0017] FIG. 3 illustrates a cross-sectional view of the display panel of FIG. 1.

[0018] FIG. 4 illustrates a cross-sectional view of a touch panel display device according to a second embodiment of the invention.

[0019] FIG. 5 illustrates a cross-sectional view of a touch panel display device according to a third embodiment of the invention.

[0020] FIG. 6 illustrates a cross-sectional view of a touch panel display device according to a fourth embodiment of the invention.

DETAILED DESCRIPTION

[0021] Hereinafter, the invention will be described more fully hereinafter with reference to the accompanying drawings, in which embodiments thereof are shown. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the scope of the invention. The drawings and description are to be regarded as illustrative in nature and not restrictive. Like reference numerals designate like elements throughout the specification.

[0022] In addition, the size and thickness of each component shown in the drawings are arbitrarily shown for understanding and ease of description, but the embodiments are not limited thereto.

[0023] In the drawings, the thickness of layers, films, panels, regions, etc., may be exaggerated for clarity. In the drawings, for understanding and ease of description, the thickness of some layers and areas is exaggerated. It will be understood that when an element such as a layer, film, region, or substrate is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present.

[0024] In addition, unless explicitly described to the

contrary, the word "comprise" and variations such as "comprises" or "comprising", will be understood to imply the inclusion of stated elements but not the exclusion of any other elements. Further, in the specification, it will be understood that when an element such as a layer, film, region, or substrate is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present.

[0025] FIG. 1 illustrates a cross-sectional view of a touch panel display device according to a first embodiment of the invention.

[0026] Referring to FIG. 1, a touch panel display device according to the first embodiment is a display device that seeks to reduce and/or prevent damage to a touch panel caused by bending stress. The touch panel display device includes a display panel 150, a polarizing plate 140, a resin layer 130, a touch panel 120, a reinforcement layer 170, and a window 110.

[0027] According to this embodiment, the display panel 150 is a constituent element for displaying an image. The display panel 150 of this embodiment is an OLED display including an organic light emitting element, but the invention is not limited thereto. A display panel such as described hereinafter may include a display panel of a liquid crystal display device, a plasma display panel device, an electric field effect display device, or an electrophoretic display device.

[0028] FIG. 2 illustrates an equivalent circuit diagram of a pixel of the display panel of FIG. 1 and FIG. 3 illustrates a cross-sectional view of the display panel of FIG. 1.

[0029] The display panel 150 includes a plurality of signal lines 21, 71, and 72 and pixels PX connected to the signal lines (such as shown in Figure 2). Each pixel PX is one of a red pixel R, a green pixel G, and a blue pixel B.

[0030] The signal line includes scanning signal lines 21 for transmitting a gate signal (or a scan signal), data lines 71 for transmitting a data signal, and driving voltage lines 72 for transmitting a driving voltage. The scanning signal lines 21 extend substantially in a row direction and almost parallel with each other, and the data lines 71 extend substantially in a column direction and almost parallel with each other. The driving voltage lines 72 are illustrated to extend substantially in a column direction, but they may extend in a row direction or be formed mesh-shaped.

[0031] Each pixel PX includes a switching transistor Qs, a driving transistor Qd, a storage capacitor Cst, and an organic light emitting element LD.

[0032] Each switching transistor Qs includes a control terminal N1, an input terminal N2, and an output terminal N3, and the control terminal N1 is connected to a scanning signal line 21, the input terminal N2 is connected to a data line 71, and the output terminal N3 is connected to the driving transistor Qd. The switching transistor Qs may transmit a data signal received from the data line 17 to the driving transistor Qd in response to the scan signal received from the scanning signal line 21.

[0033] The driving transistor Qd also includes a control terminal N3, an input terminal N4, and an output terminal N5, and the control terminal N3 is connected to the switching transistor Qs, the input terminal N4 is connected to the driving voltage line 72, and the output terminal N5 is connected to the organic light emitting element LD. The driving transistor Qd may conduct an output current ILD of which the magnitude varies according to a voltage between the control terminal N3 and the output terminal N5.

[0034] The capacitor Cst is connected between the control terminal N3 and the input terminal N4 of the driving transistor Qd. The capacitor Cst may charge a data signal applied to the control terminal N3 of the driving transistor Qd and maintains charging of the data signal after the switching transistor Qs is turned off.

[0035] The organic light emitting element LD, e.g., an organic light emitting diode (OLED), has an anode connected to the output terminal N5 of the driving transistor Qd and a cathode connected to a common voltage Vss. The organic light emitting element LD may emit light in different intensities according to an output current of the driving transistor Qd, thereby displaying an image. The organic light emitting display device LD in this case includes an organic material that inherently emits any one or at least one light of three primary colors of red, green, and blue, or may include an organic material that emits white, and the organic light emitting display device shows a desired image by a spatial sum of these colors.

[0036] The switching transistor Qs and the driving transistor Qd may be n-channel electric field effect transistors (FETs), but at least one of the switching transistor Qs and the driving transistor Qd may be a p-channel electric field effect transistor. Also, a connection relation of the transistors (Qs and Qd), the capacitor Cst, and the organic light emitting diode LD may be changed.

[0037] Next, a cross-section of the display panel 150 will be described in further detail with reference to FIG. 3.

[0038] Referring to FIG. 3, the driving transistor Qd is be formed on an insulation substrate 151 that can be made of, e.g., transparent glass or plastic. A plurality of signal lines (not shown) and a plurality of switching transistors (not shown) are formed on the insulation substrate 151.

[0039] A protective layer 153 that may be made of an inorganic material or an organic material is formed on the driving transistor Qd. When the protective layer 153 is made of an organic material, the protective layer may have a smooth surface. A contact hole 152 that partially exposes the driving transistor Qd is formed in the protective layer 153. A pixel electrode 155 is formed on the protective layer 153. The pixel electrode 155 may include a reflective electrode and a transparent electrode formed on the reflective electrode. The reflective electrode may be made of highly reflective metal such as sliver (Ag) or aluminum (Al) or an alloy thereof, and the transparent electrode may be made of a transparent conductive oxide such as indium tin oxide (ITO) or indium zinc oxide (IZO).

[0040] A pixel defining layer 154 may be formed covering the periphery area of the edge of the pixel electrode 155 on the protective layer 153.

[0041] An organic emission layer 156 is formed on the pixel electrode 155, and a common electrode 157 is formed on the organic emission layer 156 and the pixel defining layer 154.

[0042] The organic emission layer 156 may includes an emission layer (not shown) where light is substantially emitted and organic layers (not show) for efficient transmission of carriers of holes or electrodes to the emission layer. The organic layers may include a hole injection layer HIL and a hole transport layer HTP provided between the pixel electrode 155 and the emission layer and an electron injection layer EIL and an electron transport layer ETL provided between the common electrode 157 and the emission layer.

[0043] An overcoat 190 is formed as an organic layer to protect the common electrode 157 by covering the same.

[0044] A thin film encapsulation layer 158 is formed on the overcoat 190. The thin film encapsulation layer 158 may help protect the organic light emitting element EL and the driving circuit formed in the substrate 151 from an external environment by sealing.

[0045] The thin film encapsulation layer 158 may includes encapsulation organic layers 158a and 158c and encapsulation inorganic layers 158b and 158d, which are alternately layered. FIG. 3 exemplarily illustrates that two encapsulation organic layers 158a and 158c and two encapsulation inorganic layers 158b and 158d are alternately layered to form the thin film encapsulation layer 158, but the invention is not limited thereto.

[0046] Referring to FIG. 1, the polarizing plate 140 is disposed on an upper side of the display panel 150. The polarizing plate 140 may change an optical axis of light passed through the display panel 150 and then emitted to the outside. In general, the polarizing plate may be formed in a structure in which a transparent protection film is layered to both sides or one side of a polarizer that is formed of a polyvinylalcohol-based resin.

[0047] For example, the polarizing plate 140 may have a structure in which molecule chains of poly vinyl alcohol (hereinafter, referred to as PVA) are aligned in a constant direction and a tri-acetyl cellulose (TAC) film, as a protective film, is bonded to a polarizer including an iodine-based compound or a dichroic polarizing material. In this case, the polarizer and the protective film may be bonded to each other by an aqueous adhesive made of a PVA-based solution, in general.

[0048] However, the polarizing plate 140 is not limited thereto, and the structure of the polarizing plate may be variously changed.

[0049] A resin layer 130 is formed on an upper portion of the polarizing plate 140. The resin layer 130 may bond a touch panel 120 (spaced apart from an upper side of the polarizing plate 140) and the polarizing plate 140. In this case, the resin layer 130 may be formed by curing a liquid resin.

[0050] According to this first embodiment, the touch panel 120 may be spaced apart from the upper side of the polarizing plate 140 and may sense an external touch input. In an implementation, a capacitive-type touch panel may be employed as the touch panel 120. However, the touch panel 120 is not limited thereto, and a resistive type or an electro-magnetic type touch panel may be employed.

[0051] Referring to FIG. 1, the touch panel 120 may be a typical capacitive type touch panel, and includes a first insulation layer 123, an electrode portion 122, and a second insulation layer 121.

[0052] The first insulation layer 123 may be a constituent element that functions as a substrate, and an insulating substrate such as glass or PET may be used.

[0053] The electrode portion 122 formed on an upper side of the first insulation layer 123 may be formed of a plurality of X electrodes (not shown) and a plurality of Y electrodes (not shown) respectively arranged in the X direction and the Y direction when viewed from the top.

[0054] In this case, the plurality of X and Y electrodes may detect change in capacitance of each electrode due to finger touch. The electrode portion 122 may be made of a highly transmissive material, e.g., a transparent conductive material such as indium tin oxide (ITO).

[0055] The second insulation layer 121 is provided on an upper side of the electrode portion 122 to protect the electrode portion 122. In this case, the second insulation layer 121 may be formed of an insulating material such as PET.

[0056] The window 110 is disposed on an upper side of the touch panel 120. The window 110 may help protect the touch panel 120 and the display panel 150 on a lower side of the window 110.

[0057] According to this first embodiment, a reinforcement layer 170 is formed between the touch panel 120 and the window 110. However, the location of the reinforcement layer 170 is not limited thereto, and may be provided, e.g., between the window 110 and the touch panel 120 and/or between the touch panel 120 and the resin layer 130.

[0058] In this case, the reinforcement layer 170 may help prevent the touch panel 120 from being damaged due to stress generated when the display device is bent.

[0059] As previously described, cracks may be formed in an electrode formed in the electrode portion 122 upon application of a bending stress. For example, when more than a predetermined level of bending stress is transmitted to the touch panel 120, the electrode of the touch panel 120 may be damaged, thereby causing an operation failure of the touch panel 120.

[0060] Thus, in order to prevent damage to the touch panel 120 due to the bending stress, the reinforcement layer 170 is formed on an upper or lower side of the touch panel 120 to help reduce the bending stress.

[0061] FIG. 4 illustrates a cross-sectional view of a touch panel display device according to a second em-

bodiment of the invention, and FIG. 5 illustrates a cross-sectional view of a touch panel display device according to a third embodiment.

[0062] Referring to FIG. 4, a touch panel display device according to the second embodiment includes a reinforcement layer 270 formed on a lower side of a touch panel 220, e.g., between the touch panel 220 and a resin layer 230. Thus, in this embodiment, the location of the reinforcement layer 270 relative to the touch panel 220 differs from the first embodiment.

[0063] Referring to FIG. 5, a touch panel display device according to the third embodiment includes reinforcement layers 371 and 372 respectively formed on an upper side and a lower side of a touch panel 320, e.g., between window 310 and the touch panel 320 and between the touch panel 320 and resin layer 330. By having the reinforcement layers 371 and 372 disposed on both the upper and lower sides of the touch panel 320, the bending stress transmitted to the touch panel 320 may be further reduced relative to the first and second embodiments.

[0064] In an implementation, the reinforcement layer or at least one of the reinforcement layers may be made of a polysilicon or oxide semiconductor.

[0065] For example, the oxide semiconductor may include any one of oxides having titanium (Ti), hafnium (Hf), zirconium (Zr), aluminum (Al), tantalum (Ta), germanium (Ge), zinc (Zn), gallium (Ga), tin (Sn), or indium (In) as a base, and/or complex oxides thereof, such as zinc oxide (ZnO), indium-gallium-zinc oxide ($InGaZnO_4$) indium-zinc oxide (Zn-In-O), zinc-tin oxide (Zn-Sn-O) indium-gallium oxide (In-Ga-O), indium-tin oxide (In-Sn-O), indium-zirconium oxide (In-Zr-O), indium-zirconium-zinc oxide (In-Zr-Zn-O), indium-zirconium-tin oxide (In-Zr-Sn-O), indium-zirconium-gallium oxide (In-Zr-Ga-O), indium-aluminum oxide (In-Al-O), indium-zinc-aluminum oxide (In-Zn-Al-O), indium-tin-aluminum oxide (In-Sn-Al-O), indium-aluminum-gallium oxide (In-Al-Ga-O), indium-tantalum oxide (In-Ta-O), indium-tantalum-zinc oxide (In-Ta-Zn-O), indium-tantalum-tin oxide (In-Ta-Sn-O), indium-tantalum-gallium oxide (In-Ta-Ga-O), indium-germanium oxide (In-Ge-O), indium-germanium-zinc oxide (In-Ge-Zn-O), indium-germanium-tin oxide (In-Ge-Sn-O), indium-germanium-gallium oxide (In-Ge-Ga-O), titanium-indium-zinc oxide (Ti-In-Zn-O), and hafnium-indium-zine oxide (Hf-In-Zn-O).

[0066] The reinforcement layers may be made of a mixed material of an oxide semiconductor and a metal or metal compound. In this case, the metal or metal compound may be at least one of copper, ITO, and aluminum.

[0067] According to a fourth embodiment of the embodiment, a reinforcement layer 470 is formed as a plurality of layers as shown in FIG. 6. In this example, the reinforcement layer 470 is formed of a first reinforcement layer 470a and a second reinforcement layer 470b.

[0068] The first reinforcement layer 470a and the second reinforcement layer 470b may be made of the same material or respectively made of different materials. For example, the first reinforcement layer 470a and the second reinforcement layer 470b may be made of oxide semiconductors, or they may be made of a mixed material of an oxide semiconductor and a metal or metal compound. Alternatively, for example, one may be made of an oxide semiconductor and the other may be made of a mixed material of an oxide semiconductor and a metal or metal compound.

[0069] By way of summation and review, within the art generally an ITO layer may be deposited in the touch panel, and when the touch panel is bent, the ITO layer may be broken or damaged due to bending stress. To address this, a touch panel display device according to the invention may include a reinforcement layer on at least one of an upper side and a lower side of the touch panel. Thus when the display device is bent, the touch panel may be prevented from being damaged due to bending stress.

[0070] While this invention has been described in connection with what are presently considered to be practical embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims.

Claims

1. A touch panel display device, comprising:

   a display panel for displaying an image;
   a polarizing plate attached onto the display panel;
   a touch panel on and spaced apart from an upper portion of the polarizing plate;
   a resin layer between the touch panel and the polarizing plate, the resin layer bonding the touch panel and the polarizing plate;
   a window on the touch panel; and
   a reinforcement layer situated between the window and the touch panel and/or between the touch panel and the resin layer.

2. A touch panel display device according to claim 1, wherein the reinforcement layer comprises an oxide semiconductor.

3. A touch panel display device according to claim 1 or 2, wherein the reinforcement layer comprises a metal or metal compound.

4. A touch panel display device according to claim 3, wherein the metal or metal compound includes at least one of copper, ITO, or aluminum.

5. A touch panel display device according to claim 2 or any claim dependent upon claim 2, wherein the oxide semiconductor includes at least one of:

an oxide having zinc, gallium, tin, or indium as a base, or
a complex oxide of zinc, gallium, tin, or indium,

6. A touch panel display device according to claim 5, wherein the complex oxide includes at least one of indium-gallium-zine oxide, indium-zinc oxide, or zinc-tin oxide.

7. A touch panel display device according to any preceding claim, wherein the reinforcement layer includes a plurality of layers.

8. A touch panel display according to any preceding claim comprising a first said reinforcement layer situated between the window and the touch panel and a second said reinforcement layer situated between the touch panel and the resin layer.

FIG. 1

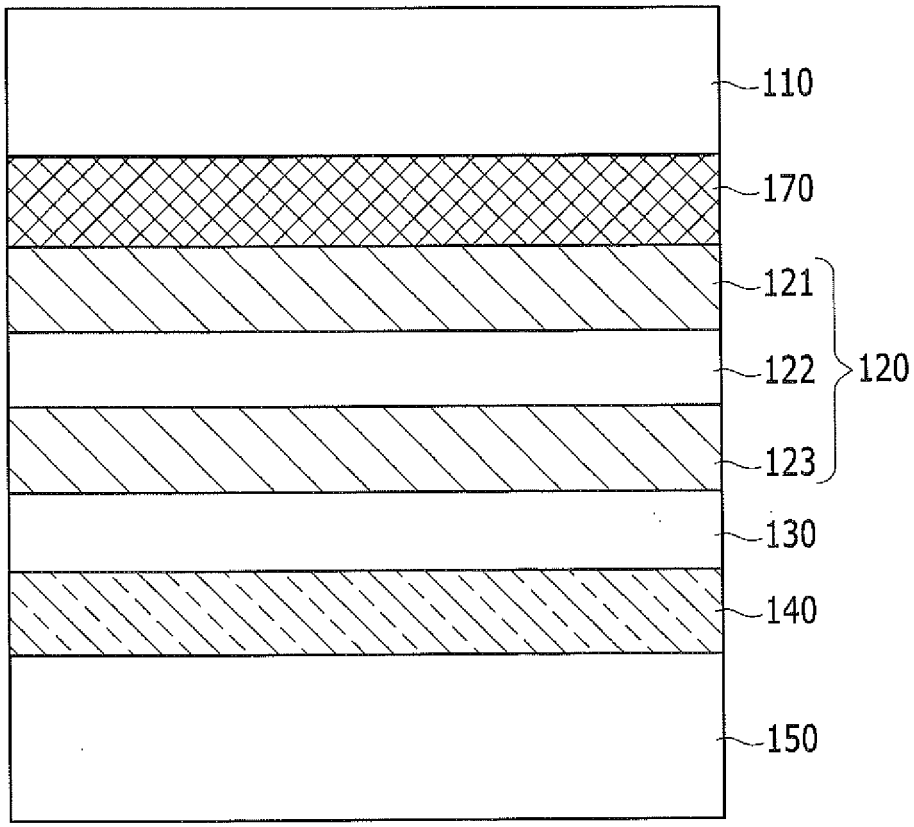

FIG. 2

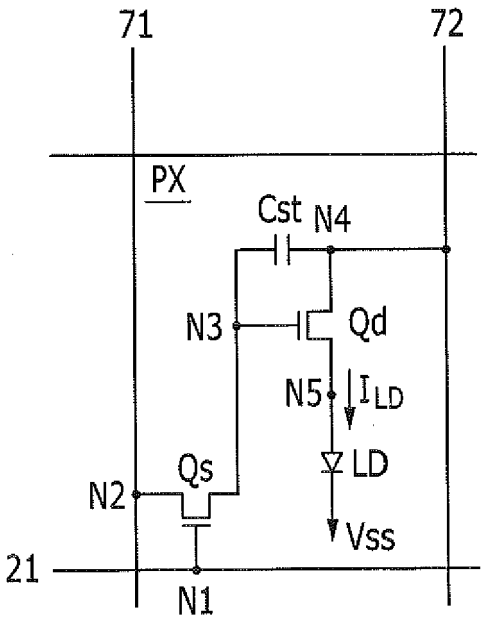

FIG. 3

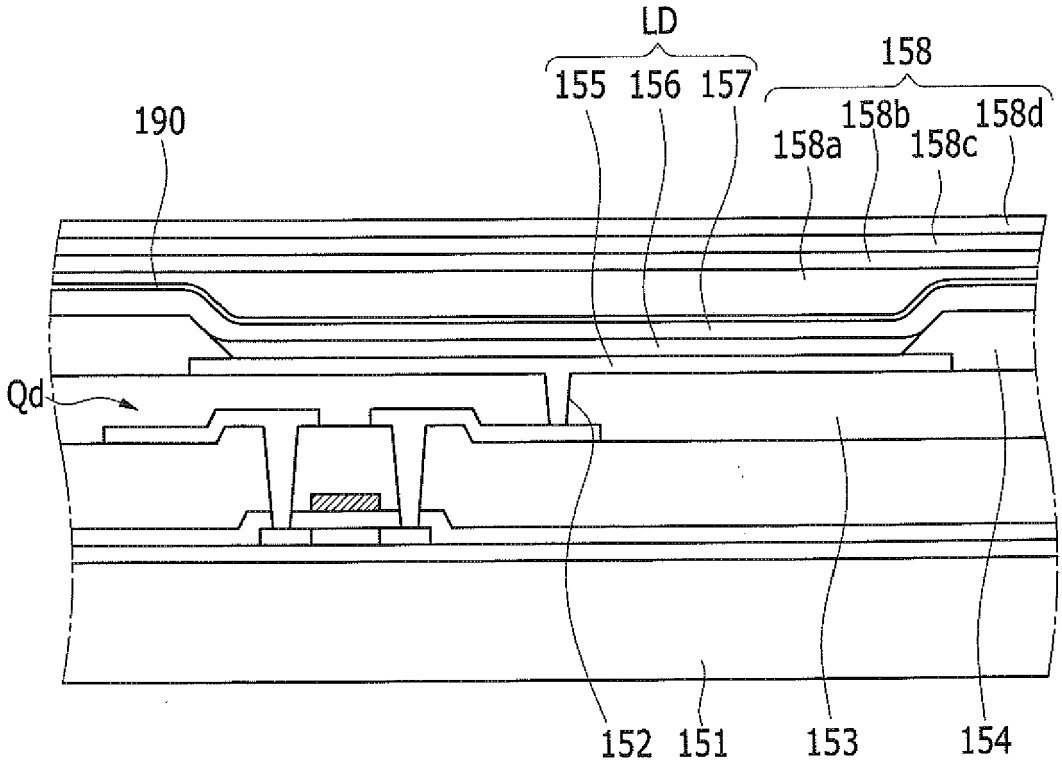

FIG. 4

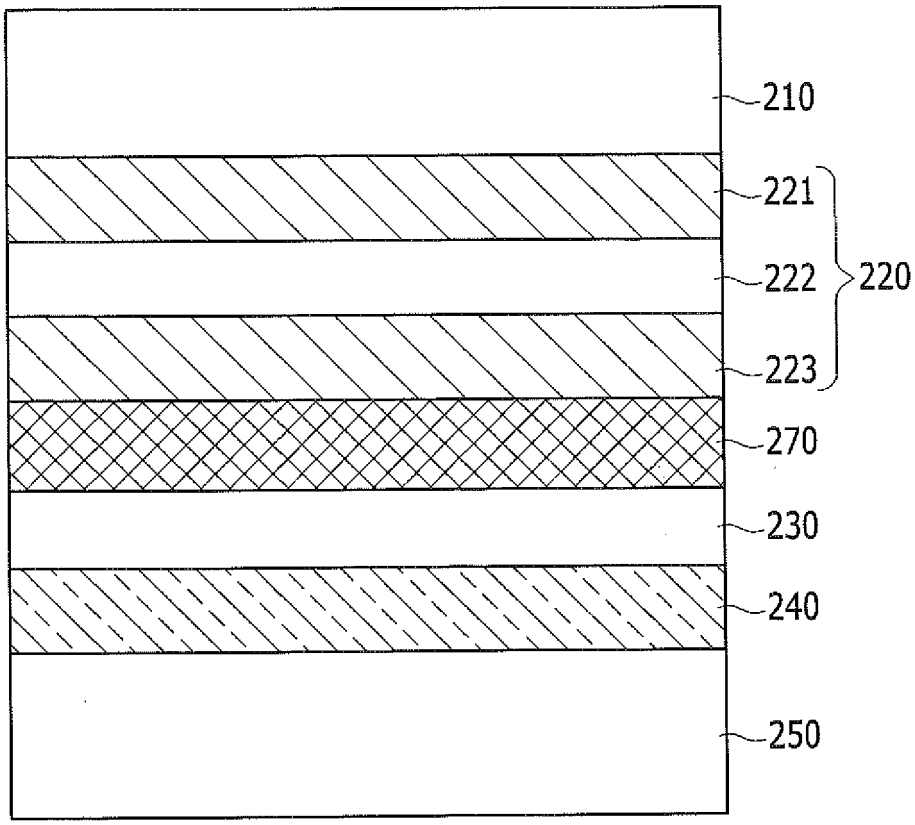

FIG. 5

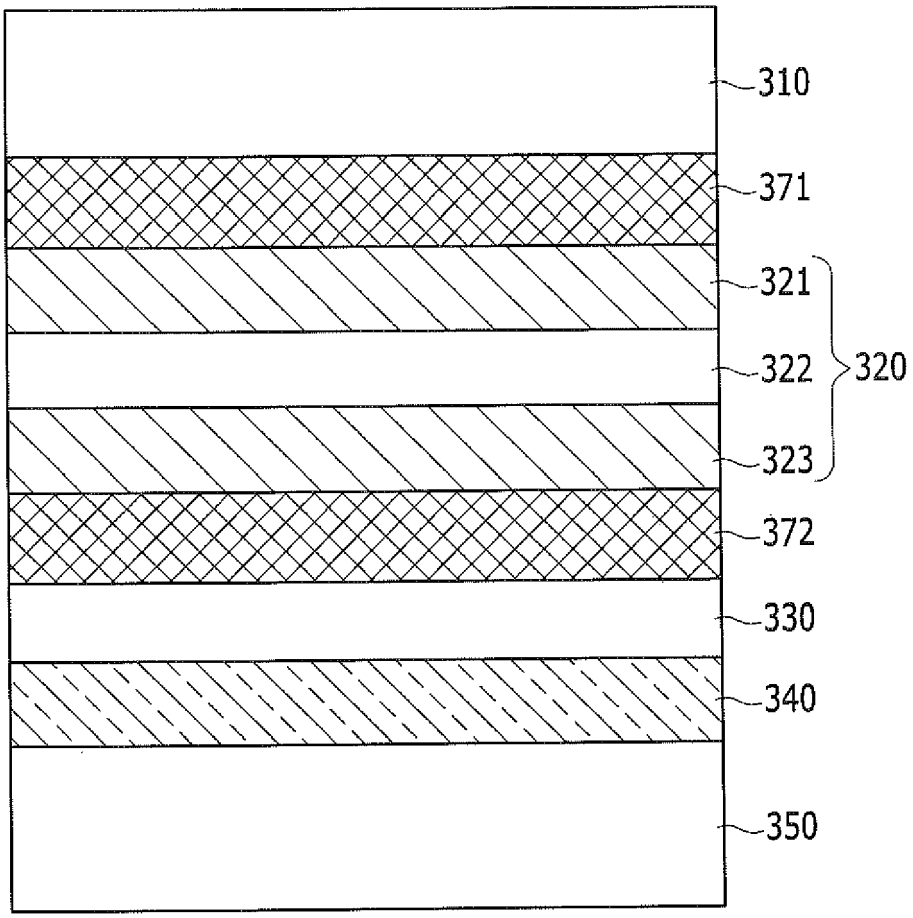

FIG. 6